

IMPROVED LED EFFICIENCY USING PHOTONIC CRYSTAL STRUCTURE

Michael R. Krames

Mihail M. Sigalas

Jonathan J. Wierer, Jr.

ABSTRACT OF THE DISCLOSURE

A photonic crystal light emitting diode ("PXLED") is provided. The PXLED includes a periodic structure, such as a lattice of holes, formed in the semiconductor layers of an LED. The parameters of the periodic structure are such that the energy of the photons, emitted by the PXLED, lies close to a band edge of the band structure of the periodic structure. Metal electrode layers have a strong influence on the efficiency of the PXLEDs. Also, PXLEDs formed from GaN have a low surface recombination velocity and hence a high efficiency. The PXLEDs are formed with novel fabrication techniques, such as the epitaxial lateral overgrowth technique over a patterned masking layer, yielding semiconductor layers with low defect density. Inverting the PXLED to expose the pattern of the masking layer or using the Talbot effect to create an aligned second patterned masking layer allows the formation of PXLEDs with low defect density.